

CLAIMS

1. Liner conversion apparatus adapted to convert a flexible liner (2), including a layer of composite material (3) comprising thermoplastics material and reinforcing fibres, into a structural member within a duct (1), comprises a front portion (6) adapted to be inserted in the liner (2), a central portion (7) having heating means (8) on one side of the layer of composite material (3), and a rear portion (10) having consolidation means (11) for forcing the heated layer of composite material (3) towards the duct (1) for consolidation and cooling under pressure to form the structural member, the heating means (8) producing pressurised hot gas, the central portion (7) being so constructed and arranged to force the hot gas under pressure through the layer of composite material (3) to heat the layer, and to provide an air gap (14) on the opposite side of the layer of composite material (3) while heating takes place, characterised in that a further heating means (43), which substantially surrounds the heating means (8) and is on an opposite side of the composite layer (3) to that of the heating means (8), is adapted to ensure uniform heating of both the liner (2) and composite material (3).
2. Liner conversion apparatus according to claim 1, characterised in that the further heating means (43) is a passive heating device.
3. Liner conversion apparatus according to claim 1, characterised in that the further heating means (43) is an active heater, containing a heating element.
4. Liner conversion apparatus according to any preceding claim, characterised in that the central portion (7) has inner and outer members, one of which has the heating means (8), and the other the further heating means (43).

5. Liner conversion apparatus according to claim 4, characterised in that the member with the further heating means (43) also acts as support means (9) to provide the air gap (14).

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6. Liner conversion apparatus according to claim 4 or claim 5, characterised in that the inner member has the heating means (8), so that the layer of composite material (3) is heated from the inside, while the outer member comprises the further heating means (43).

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7. Liner conversion apparatus according to any of claims 4 to 6, characterised in that the outer member is annular, surrounding and spaced from the inner member.

15 8. Liner conversion apparatus according to claim 4, characterised in that the outer member has the heating means (8), so that the layer of composite material (3) is heated from the outside, while the inner member comprises the further heating means (43).

20 9. Liner conversion apparatus according to any preceding claim, characterised in that the hot gas is directed from the air gap forwardly to provide pre-heating of the liner (2) at the front portion (6).

10. Liner conversion apparatus according to any preceding claim,
25 characterised in that the hot gas is produced by heating a supply of compressed air.

11. Liner conversion apparatus according to any preceding claim, characterised in that unheated compressed air is used as the consolidation
30 means (11) forcing the heated layer of composite material into contact with the duct (1).

12. Liner conversion apparatus according to any preceding claim, characterised in that the compressed air inflates a flexible bag means (11) which acts on the layer of composite material (3).

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13. Liner conversion apparatus according to claim 12, characterised in that the flexible bag means (11) is attached to the central portion (7).

14. Liner conversion apparatus according to claim 12, characterised in that the flexible bag (11) is expanded from the rear, unrolling as it does so.

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15. Liner conversion apparatus according to any of claims 12 to 14, characterised in that the flexible bag (11) is of plastics.

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16. Liner conversion apparatus according to claim 15, characterised in that the flexible bag (11) is of PVC.

17. Liner conversion apparatus according to claim 12 to 14, characterised in that the bag (11) is of silicon based material.

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18. Liner conversion apparatus according to any preceding claim, characterised in that the liner (2) includes an outer thermoplastics layer (4) between the duct (1) and the layer of composite material (3).

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19. Liner conversion apparatus according to any preceding claim, characterised in that the apparatus is moved along the duct (1) by being winched from its front portion (6).

20. Liner conversion apparatus according to any preceding claim, characterised in that compressed air and power for the heating means (8) are supplied through lines (25) attached to the apparatus.

- 5 21. Liner conversion apparatus according to any preceding claim, characterised in that a mobile unit (15) generates the compressed air supply and the power, for example electricity, to operate the apparatus.